Illustration, distribution and cultivation of *Lachnagrostis robusta, L. billardierei* and *L. punicea* (Poaceae)

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Abstract

Illustrations are presented for *Lachnogrostis robusto, L. billardierei* subsp. *billardierei, L. billordierei* subsp. *tenuiseta, L. puniceo* subsp. *puniceo* and *L. puniceo* subsp. *filifolio* as a supplement to an earlier paper (Brown and Walsh 2000) which provided a taxonomic revision of these grasses. Distributions of a number of these taxa within South Australia and Victoria are updated and the results of morphological and phenological observations under nursery conditions are reported.

Keywords: morphology, phenology, taxonomy, grasses

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Introduction

Brown and Walsh (2000) published new combinations for some varieties of *Agrostis billardierei* R.Br. and *A. aemula* R.Br.: *A. billardierei* var. *robusta* Vickery as *A. robusta* (Vickery) A.J.Br. & N.G.Walsh, *A. billardierei* var. *filifolia* Vickery as *Agrostis punicea* A.J.Br. & N.G.Walsh var. *filifolia* (Vickery) A.J.Br. & N.G.Walsh, *A. billardierei* var. *collicola* D.I.Morris as *A. collicola* (D.I.Morris) A.J.Br. & N.G.Walsh and *A. aemula* var. *setifolia* Vickery as *A. punicea* var. *punicea*. Subsequently, Jacobs (2001, 2002, 2004) transferred these and other related taxa to *Lachnagrostis* Trin. and raised the rank of varieties to subspecies, thus: *L. robusta* (Vickery) S.W.L.Jacobs, *L. billardierei* (R.Br.) Trin. subsp. *billardierei, L. billardierei* subsp. *tenuiseta* (D.Morris) S.W.L.Jacobs, *L. collicola* (D.Morris) S.W.L.Jacobs, *L. punicea* (A.J.Br. & N.G.Walsh) S.W.L.Jacobs subsp. *punicea* and *L. punicea* subsp. *filifolia* (Vickery) S.W.L.Jacobs.

Since that time, further field work has discovered new populations of some of these taxa in South Australia and Victoria, which either consolidates or extends their distribution.

Some taxa have also been subjected to cultivation under potted nursery conditions, to observe growth habit and flowering patterns and to examine whether any further taxonomic differentiation is warranted. This paper reports on these studies and uses the opportunity to illustrate the taxa, which was not undertaken in the original paper.

Methods

Field survey

Information was collated on additional populations of the study taxa, which had been discovered in the field or redetermined from previously collected herbarium material, in the 12 years since the original paper was published.

Pot trials

Seed harvested during 1996–99 from five Victorian populations of *Lachnagrostis robusta* (Table 1) was sown into seedling mix (potting

mix, sand and perlite) on 26 September 2001 under glasshouse nursery conditions. Eight seedlings per accession at 3- or 4-leaf stage, were transferred on 21 November 2001 to 15 cm diam. pots containing a slow-release fertilised, pinebark based, potting mix and grown on for two seasons on outdoor benches on a lawn at the Department of Primary Industries Werribee Centre. Water was applied as required, with an overhead sprinkler. Measurements of overall plant height (vertical height), maximum leaf width, leaf condition (inrolled, folded or flat) and inflorescence number were made periodically throughout the growing season. At the start of the second season, two year old plants of *L. billardierei* subsp. *billardierei*, *L. billardierei* subsp. *tenuiseta*, *L. punicea* subsp. *punicea* and *L. punicea* subsp. *filifolia* (Table 1) that had survived (1-4 plants per accession) from a previous pot trial were repotted and added to the outdoor trial, for which the onset of flowering and inflorescence numbers were recorded.

Further seed harvests during 2008–10 (Table 1) provided seedlings for use in growth observation trials over the 2010–11 and 2011–12 growing seasons at the Royal Botanic Gardens Melbourne Nursery. In the first trial, glasshouse raised seedlings were transferred to 10 cm diam. pots and repotted to a slow-release fertilised, pinebark based mix in 15 cm diam. pots for observation during October-February 2010–11. Four plants from one accession per taxon were selected for assessment. Plants were kept in a shade-house with one automatic watering per day in the cooler months and two waterings per day in the warmer months. Measurements of overall plant height, maximum length (i.e. longest plant extension in any direction), maximum leaf width and leaf condition were made prior flowering. The second trial was similar to the first, except that seedlings were transferred directly into 15 cm diam. pots and placed on a low, steel open-mesh grill over an outdoor, concrete pad and automatically watered on a daily basis. For this trial, only one plant per accession was grown but multiple accessions per taxon were represented for *L. billardierei* subsp. *billardierei*, *L. punicea* subsp. *punicea* and *L. robusta*.

Results

Field survey

Lachnagrostis robusta

Many new populations of this species were found in the more saline waterways of inland sites in South Australia. In addition, its known distribution is now extended into Kangaroo Island and Yorke Peninsula. An old collection of *L. filiformis* (G.Forst.) Trin. was also redetermined as *L. robusta* from the Eyre Peninsula. A few collections were also made from saline lake flats in the southern Wimmera district of Victoria; thereby extending its known distribution northward in that State. Fig 1a-e.

Table 1. Vouchers for accessions of *Lochnogrostis* taxa used in nursery observation trials.

Taxon	Trial Period	Vouchers
L. robusta	2001-03	Salt Swamp, Vic., *A.J.Brown 1225* (MEL); Willaura, Vic., *A.J.Brown 1102* (MEL); Lake Linlithgow, Vic., *A.J.Brown 2525* (MEL); Skipton, Vic., *A.J.Brown, 863* (MEL); Carranballac, Vic., *A.J.Brown, 14B3* (MEL)
	2011-12	Carranballac, Vic., *A.J.Brown 14B3* (MEL); Telfers Swamp, Vic., *A.J.Brown 2336* (MEL); Holm Hill, SA, *R.J.Botes B0B01* (MEL); Lenunga, SA, *R.J.Bates 75793* (MEL)
L. billardierei* subsp. *billardierei	2002-03	Swan Bay, Vic., *A.J.Brown 1469* (MEL); Walkerville, Vic., *A.J.Brown 1554* (MEL); St Marnocks, Vic., *A.J.Brown 111B* (MEL)
	2010-12	St Marnocks, Vic., *A.J.Brown 111B* (MEL); Tilley Swamp, SA, *A.J.Brown 1606* (MEL); Reedy Creek, SA, *R.J.Bates 757B6* (MEL); Piccaninnie Ponds, SA, *A.J.Brown 1739* (MEL); Mitre Lake, Vic., *A.J.Brown 2327* (MEL); Emita Beach, Tas., *A.J.Brown 24B0* (MEL)
L. billardierei* subsp. *tenuiseta	2002-03	Dolphin Sands, Tas., *A.J.Brown 157B* (MEL); Mayfield Beach, Tas., *A.J.Brown 15B5* (MEL); Kelvedon Beach, Tas., *A.J.Brown 1579* (MEL)
	2010-12	Kelvedon Beach, Tas., *A.J.Brown 1579* (MEL)
L. punicea* subsp. *punicea	2002-03	Dartmoor, Vic., *A.J.Brown 1511* (MEL), *A.J.Brown 2175* (MEL); South Bulart, Vic., *A.J.Brown 2523* (MEL)
	2010-12	Dartmoor, Vic., *A.J.Brown 2175* (MEL); South Bulart, Vic., *Brown A.J. 2523* (MEL)
L. punicea* subsp. *filifolia	2002-03	South Bulart, Vic., *A.J.Brown, 1270* (MEL)
	2010-12	South Bulart, Vic., *A.J.Brown, 1270* (MEL)

Figure 1: *Lochnogrostis robusta*: **a** tussock x0.3, **b** spikelets x5, **c** anther x10, **d** floret, lateral view x10 (detail x20), **e** floret, dorsal view x10 (*A.J.Brown 1149* MEL2133221). *L. puniceo* subsp. *punicea*: **f** floret, lateral view x10 (*A.J.Brown 1047* MEL2131439). *L. puniceo* subsp. *filifolio*: **g** floret, lateral view x10, **h** anther x10, **i** tussock x0.3, **j** spikelets x5 (*A.J.Brown 1473* MEL2125359).

***Selected specimens exomined*: SOUTH AUSTRALIA:** Todd River, Eyre Peninsula, 9.xii.1968, *C.R.Alcock 2605* (AD); Lake Kitty, Kangaroo Island, iv.2000, *R.J.Botes s.n.* (AD); Murray Lagoon, Kangaroo Island, 15.iv.2000, *R.J.Botes 561B6* (AD); Eudunda Creek, 12.ii.2000, *R.J.Botes 55B96* (AD); 3km E of Rockleigh, 26.ii.2003, *D.E.Murfet 4320* (AD); 5km NE of Saddleworth, 30.xii.2003, *R.J.Botes 62040* (AD); Creek near Marrobel, 16.ii.2005, *R.J.Botes 6477B* (AD); Pondalowie Firetrack (Innes National Park), Yorke Peninsula, 30.v.2006, *T.Joques INP21B & T.Lewis* (AD); Murraytown, 13.xii.2007, *R.J.Botes 76203* (MEL), Limy Creek (Mt Remarkable National Park), 13.xii.2007, *R.J.Botes 76244* (MEL); Bundaleer Reservoir, 16.i.2008, *R.J.Botes 76B95* (AD); Koonoona Station, 16.i.2008, *R.J.Botes 76727* (AD); Goodnadigby, 17.i.2008, *R.J.Botes 76B96* (AD); Magpie Creek, E of Brinkworth, 17.i.2008, *R.J.Botes 76B97* (AD); **VICTORIA:** Norval, 24.xii.2003, *A.J.Brown 2341* (MEL); Telfers Swamp, 17.xi.2004, *A.J.Brown 1760* (MEL); North Lake, 31.i.2003, *A.J.Brown 2346* (MEL).

***Correction to Brown and Walsh (2000)*, p. 83:** Skipton, 11.i.1994, *Brown 870* (MEL) should be *Brown 863*.

Lachnagrostis billardierei subsp. *billardierei*

Of particular interest are those new populations that occur well inland from the normal SW Victoria or SE South Australia coastal habitat of this taxon. A number of the new sites are on ephemeral lakes and swamps associated with dune systems stranded by the Mid-Pleistocene coastline regression of the ancient epeiric Murray Basin. However, whether *L. billardierei* is part of a remnant vegetation or a more recent invasion to these sites, is not known. The taxon also occurs sporadically along spring-fed creek lines and gorges of the Lofty Ranges and the Lower Glenelg River, where these relatively protected and continuously watered environments can produce large tussocks with very large panicles. In some environments, such as in *Leptospermum lanigerum* (Sol. ex Aiton) Sm. swamp, culms may be rather long and straggling and leaves more flaccid than usual. Fig. 2a-e.

***Selected specimens examined*: SOUTH AUSTRALIA:** Eerie Swamp, Comaum, 8.xii.1990, *K.Alcock 62* (MEL); Rockleigh, 26.ii.2003, *D.E.Murfet. 4319* (AD); Brady Creek, i.xi.2003, *L.M.B.Heord BS1621160 & N.R.Neogle* (AD); Glenburnie Gorge, xi.2003, *R.J.Botes 619B3* (AD); Saddleworth, 30.xii. 2003, *A.J.Brown 1741* (MEL); Rhynie, 30.xii.2003, *A.J.Brown 1742* (MEL); Yakilo Water Reserve, 4.xi.2004, *J.Turner BS1623442 & A.Brown* (AD); Logan Morass, xi.2005, *R.J.Botes 66916* (AD); Tarlee, 2.xii, 2005, *P.J.Ainsley104 & A.Clorke* (AD); Noolook Forest Reserve, 2.xi.2007, *R.J.Botes 75796* (MEL). **VICTORIA:** Wanwin Falls, Dartmoor, i.2001, *R.J.Bates 5B031* (AD); Mitre Lake, 11.xii.2002, *A.J.Brown 232B* (MEL); Tooan Lake, 12.xii.2002, *A.J.Brown 2334* (MEL); White Lake, 31.i.2003, *A.J.Brown 2332* (MEL); North Lake, 31.i.2003, *A.J.Brown 2333* (MEL); Skipton, 23.xii.2003, *A.J.Brown 1740* (MEL); Ararat, 1.xii,2004, *A.J.Brown 1743* (MEL); Salt Creek, Poolaigelo, 18.i.2006, *A.J.Brown 1744* (MEL).

***Correction to Brown and Walsh (2000)*, p. 80:** St. Marnock's Swamp, Crossroads, south of Eurambeen, 4.i.1996, *Brown 1117* (MEL) should be *Brown 1118*.

Lachnagrostis billardierei subsp. *tenuiseta*

No new populations of this taxon have been recorded for Tasmania since 2000. However, examination of New Zealand specimens of *L. billardierei* has revealed a number of collections with very short, straight awns, reminiscent of subsp. *tenuiseta*; a taxon not formerly recorded in that country. A few on-loan collections of New Zealand material were available for measurement of vegetative and floret characters (Table 2) and these show that at least some New Zealand specimens of subsp. *billardierei* are comparable in leaf size to the Australian plants (as given by Brown and Walsh 2000), while spikelet and floret size are at the upper end of the Australian range. Comparisons between Australian subsp. *tenuiseta* and the New Zealand apparent subsp. *tenuiseta* specimens show similar features, except that the reduced lemma awns on the New Zealand material are attached near the mid-back point (43-59% of the lemma length, from the base), while the Australian examples have awns attached at 69% of the lemma length or higher. The Australian plants have lemma awns (where present) that are always fine and bristle-like, generally extending beyond the lemma tip. Only one of the New Zealand examples (Taumataraea, *de Lange 6109 & Gardner*) examined had a bristle-like lemma awn but unlike the Australian plants, this appeared to be readily deciduous from a minute basal attachment. The other New Zealand examples had, when present at all (including on lemmas fully enclosed by the glumes), what appeared to be, a much reduced and tightly appressed, awn column only. Two of the apparent subsp. *tenuiseta* collections provide habitats as "open dunes with marram grass" and "dune vegetation at rear of beach" while the New Zealand collections of subsp. *billardierei* derive from "rock-soil interface above high tide level" and "rock crevice above beach". These habitat

Figure 2: *Lachnagrostis billardierei* subsp. *billardierei*: **a** partial mature tussock x0.3, **b** partial mature tussock with emerging inflorescences x0.3, **c** spikelet x10, **d** anther x10, **e** floret, lateral view x10 (*A.J.Brown 1526* MEL2133133). *Lachnagrostis billardierei* subsp. *tenuiseta*: **f** spikelet x10, **g** anther x10, **h** floret, lateral view x10, **i** tiller with maturing inflorescence (*A.J.Brown 15B5* MEL2133144).

Table 2. Ranges of some morphological characters for *L. billordierei* ssp. from Australia and New Zealand.

Character	ssp. *billardierei* Australia	ssp. *billardierei* New Zealand	ssp. *tenuiseta* Australia	appar. ssp. *tenuiseta* New Zealand
No. collections examined	26	2	7	3
Flag leaf width, mm	2-8	3-4.5	1.5-4	1.5-2
Flag leaf length, mm	4.5-27	10-11	5-12	7.5-12.5
Spikelet gape[1]	1-4	3-4	1-2	2-4
Lower glume length, mm	3.1-6.7	5.2-5.8	4.4-5.7	4.6-5
Lemma length, mm	2.4-4.3	3.5-4.5	2.9-3.3	2.8-3.5
Lemma setae length, mm	0.1-1	0.6-0.8	0-0.2	0.2-0.3
Palea length, mm	1.7-2.9	2.2-3	2.1-2.5	2.0-2.5
Rachilla extension, mm	1.7-3	2.7-3.4	2-3	1.8-2.5
Awn length, mm	3.6-9	5.4-8.3	0-1.9	0.3-1.5
Awn attachment, % of lemma	29-47	38-39	69-94	43-59
Anther length, mm	0.5-1	0.7-1	0.5-0.8	0.6-0.7

[1] score: 1 = nil or scarely gaping outer glumes, 2 = slightly gaping outer glumes (up to 10°), 3 = moderately gaping outer glumes (10° to 30°), 4 = widely gaping outer glumes (>30°).

differences are not dissimilar to the Australian habitats for subsp. *tenuiseta* and subsp. *billardierei* (Brown and Walsh 2000). Despite this similarity, the morphological evidence suggests a (at least one) separate genesis for these New Zealand specimens, apart from the Australian subsp. *tenuiseta*. Further and broader examination of both morphological and genetic features of these entities would be needed to resolve their relationship. Fig. 2f-i.

***Specimens examined*: AUSTRALIA:** see Brown and Walsh 2000. **NEW ZEALAND:** *Lochnogrostis billordierei* subsp. *billordierei*: Kahangaroiti, Cavalli Islands, 30.xii.1978, *A.E.Wright 2B96* (AK); Panaki Island, Cavalli Island Group, 5.i.1979, *A.E.Wright 3067* (AK). *Lachnagrostis billardierei* apparent subsp. *tenuiseto*: Taumataraea Point, Laington, 14.iv.2004, *P.J.de Longe 6109 & R.O.Gordner* (AK); Ngungura Bay, 23.xi.2000, *W.Porr s.n.* (AK); Uretiti Beach, S of Ruakaka, 17.xi.1992, *M.L.Fromont s.n.* (AK).

Lachnagrostis punicea subsp. *punicea*

Prior to 2000, the majority of collections had been made in Victoria (Brown and Walsh 2000). With only three previous collections of this taxon known from South Australia, new collections made in the South-east since 2000 have consolidated its occurrence in that region of the State. Some additional collections in Victoria were made on the periphery of the known distribution. Fig 1f.

***Selected specimens examined*: SOUTH AUSTRALIA:** Brim Swamp, 29.xi.2004, *D.E.Murfet 4B10* (AD); Honans Forest Reserve, Glencoe, iii.2005, *R.J.Botes 65001* (AD); Whennans Native Forest Reserve, Mt Burr, i.2006, *R.J.Botes 67652* (AD); Near Lake Beachport, 18.i.2006, *R.J.Botes 67673* (AD); Penola Conservation Park, 20.xii.2007, *R.J.Bates 7634B & A.J.Brown* (AD); McRostie Native Forest Reserve, 21.xii.2007, *R.J.Botes 76704 & A.J.Brown* (AD). **VICTORIA:** Norval, 24.xii.2003, *A.J.Brown 2338* (MEL); Glenisla, 7.xii.2005, *A.J.Brown 2294* (MEL); Lake Mundi, 17.i.2006, *A.J.Brown 2297* (MEL); Dergholm, 19.ii.2008, *A.J.Brown 2042* (MEL); Dartmoor, 7.i.2009, *A.J.Brown* 2175 (MEL).

Correction to Brown and Walsh (2000), p. 85: Digby, 3.xii.1998, *Brown 1512* (MEL) should be *Brown 1511*.

Lachnagrostis punicea subsp. *filifolia*

A few new collections were made in south-east South Australia. Unlike in Victoria, mixed populations of the two subspecies of *L. punicea* are yet to be found in South Australia. Fig 1g-j.

***Selected specimens examined*: SOUTH AUSTRALIA:** East Avenue, 100m E of Murrangombah turnoff 20.xi.2007, *R.J.Bates 757B7* (MEL); East Avenue, 50m E of Lenunga Homestead gate, 20.xi.2007, *R.J.Bates 75BB9 (AD)*; Salt Well Road, between Highway and Cape Jaffa, 22.xi.2007, *R.J.Bates 75724* (MEL); Mary Seymour Conservation Park, 20.xii.2007, *R.J.Bates 76327 & A.J.Brown* (AD); **VICTORIA:** Glenisla Crossing, 7.xii.2005, *A.J.Brown 2295* (MEL).

Correction to Brown and Walsh (2000), p. 86: Lake Goldsmith, Stockyard Hill, 6.xii.1998, *Brown 1189* (MEL) should be *Brown 1180*.

2001-03 pot trials

A comparison of the five accessions of *L. robusta* (Table 3) shows little difference between them in most characters, except that the Salt Swamp accession was slightly taller at the first measurement (8 weeks post sowing), mean leaf width was slightly greater in the early part of the season, the onset of flowering was delayed by 1-2 weeks and overall inflorescence numbers were lower (e.g. 54% lower than the next lowest; Lake Linlithgow, at 20 weeks post sowing). In late winter, between the growing seasons, the Skipton accession showed the least mean green leaf and the lowest mean dry inflorescence retention, though values varied widely across replicates (Table 3).

In the following season, onset of flowering was some 8 weeks earlier than for the previous season, except for the Salt Swamp accession which was only 2 weeks earlier. Second year inflorescence numbers were lower than first year results for all accessions, ranging from 31% less for Carranballac to 94% less for Salt Swamp, and flowering had finished by the end of January.

Onset of flowering in *L. robusta* was generally later by 3 weeks than *L. punicea*, was straddled by flowering time in *L. billardierei* subsp. *billardierei* and was 1-4 weeks earlier than for *L. billardierei* subsp. *tenuiseta*. Except for the Carranballac accession of *L. robusta*, plants of *L. billardierei* subsp. *billardierei* produced the highest inflorescences numbers (from 37-46 per plant). Overall, plants of *L. billardierei* subsp. *tenuiseta* produced the lowest number of inflorescences, with the Dolphin Sands and Kelvedon Beach accessions producing means of 4 and 5 inflorescences per plant only and

Table 3. Means and ranges in plant measurements for *Lochnogrostis robusto* accessions grown under outdoor conditions in the 2001-2002 growing season.

Measurement	Salt Swamp	Willaura	Lk Linlithgow	Skipton	Carranballac
8 weeks post sowing (21 November 2001)					
Tussock height, cm	33 (30-35)	29 (22-32)	26 (21-30)	26 (23-31)	23 (20-25)
No. of tillers	10 (6-13)	10 (7-13)	11(7-19)	9 (6-12)	9 (8-11)
Leaf width, mm	2.8 (2.5-3.0)	2.1 (1.5-2.5)	1.9 (1.5-2.5)	2.0 (2.0-2.5)	1.8 (1.5-2.0)
Leaf inroll score[1]	0.3	0.5	0.5	0.7	0.6
12 weeks post sowing (19 December 2001)					
Tussock height, cm	36 (27-44)	31 (26-34)	30 (26-35)	30 (25-35)	25 (21-31)
Leaf width, mm	5.4 (4.5-6.0)	4.3 (3.0-7.0)	4.4 (3.5-5.0)	4.5 (4.0-5.0)	3.7 (3.0-4.5)
Leaf inroll score[1]	0.7	0.7	0.5	0.5	0.6
14 weeks post sowing (3 January 2002)					
Tussock height, cm	34 (30-43)	34 (30-39)	37 (34-40)	32 (28-36)	31 (25-35)
Leaf width, mm	5.0 (4.0-6.0)	4.5 (3.5-5.5)	4.7 (4.0-5.5)	4.3 (3.5-5.0)	4.6 (4.0-5.0)
Leaf inroll score[1]	0.8	0.8	0.9	0.8	0.6
Emergence of 1st inflorescence, weeks post sowing	19	18	17	17	17
20 weeks post sowing (13 February 2002)					
Overall plant height, (incl. inflores), cm	53 (51-56)	50 (49-53)	55 (52-59)	50 (48-51)	51 (48-53)
Leaf width, mm	3.9 (2.5-5.5)	3.9 (3.5-4.5)	3.6 (3.5-4.0)	3.4 (3.0-3.5)	4.3 (4.0-4.5)
Leaf inroll score[1]	1.0	1.3	1.0	1.0	2.0
Inflorescence (green) number per plant	18 (3-29)	48 (38-56)	39 (21-50)	53 (39-69)	52 (41-64)
22 weeks post sowing (6 March 2002)					
Inflorescence (green) number per pot	49 (31-60)	72 (62-81)	68 (52-79)	65 (44-93)	78 (68-87)
No. disarticulated inflorescences	none	many	few	many	many
11 months post sowing (14 August 2002)					
Green leaf, % of tussock	23 (20-30)	33 (20-40)	20 (1-30)	8 (1-20)	38 (30-40)
Leaf inroll score[1]	3.0	3.0	3.0	3.0	3.0
Inflorescence (dry) number per plant	9 (5-15)	13 (9-20)	19 (13-25)	4 (2-9)	12 (6-16)
Second season (January 2003)					
Inflorescence (green) number per live plant	5 (3-7)	18 (11-33)	28 (21-34)	10 (0-17)	54 (42-64)

[1] mean values for leaf inrolling; scored as: nil =0, very slight = 0.5, slight = 1, moderate = 2, full = 3

the Mayfield Beach accession producing a mean of 18. Mean inflorescence numbers for *L. robusta* and *L. punicea* (combined subspp.) were similar at 23 and 28 respectively.

2010-12 pot trials

Plants grown under shade-house conditions were either taller or longer or both than those grown outside (Table 4). Shade-house plants of *L. robusta* and *L. punicea* in particular grew very long over time, lodging to form long trailing culms with entangled inflorescences that generally failed to disarticulate when mature. Although also growing rather lanky culms, inflorescences of *L. billardierei* retained their ability to maintain separateness and readily disarticulate. Leaf width was also increased under shade-house conditions compared to outdoor. Leaves of *L. billardierei* remained flat under both conditions, while leaves of most, though not all, outdoor plants of *L. robusta* and *L. punicea* had a tendency to inroll, even if not strongly.

Discussion

Although the data presented in this paper is an amalgamation of a series of potted growth studies and is therefore not consistent in methodology, some overall comments can still be made.

Lachnagrostis robusta

The slight but noticeable differences in vegetative size and the onset of flowering between the *L. robusta* accession from Salt Swamp and the other accessions (Table 3) may be due to its more south-easterly and near-coastal location (5 km NW of Barwon Heads and part of the Lake Connewarre and Barwon River wetland complex). The other populations of *L. robusta* in the 2001–02 trial, derived from inland ephemeral salt lake or swamp sites in the Western District of Victoria, where plants are likely to be adapted to more sporadic soil moisture content, slightly higher summer temperatures and shorter seasons. Brown and Walsh (2000) provided means for 75 *L. robusta* field-collected herbarium specimens from across SE Australia, of 48 cm, 27 cm and 0.6 mm for overall height, tussock height and leaf width, respectively. The height measurements are comparable to those measured in the 2001–02 trial (Table 3) and the 2011–12 outdoor trial (Table 4) but leaf width is considerably narrower. The normal field condition for *L. robusta* is to have inrolled leaves (Brown and Walsh 2000), presumably as a consequence of the stress imposed by its saline (and therefore moisture stressed) habitat. In all the pot trials, the plants were free of salt stress and hence leaf inrolling was not readily expressed. In the 2001–02 trial, leaf rolling was generally nil to very slight at the start of the season and became slight to moderate as summer proceeded. Not until the end of the following winter, when the pots were root-bound, did the leaves display their typical full inrolling character. In the one example of *L. robusta* (Carranballac) grown under shade-house conditions (Table 4), the leaves were completely flat and somewhat wider than for the outdoor example. The lank and lodged growth with entangled inflorescences observed under shade-house conditions would never be found in the field where the species always grows in open, non-shaded conditions, even if growing around and through *Juncus* and *Gahnia* tussocks. The reduction in inflorescence numbers between the first and second year plants of the 2001–03 seasons (Table 3) is likely to reflect some moisture and nutrient limitations due to the root bound conditions imposed by not dividing and repotting the plants; limitations not expected to be found in the field except during drought conditions.

Lachnagrostis billardierei

As for *L. robusta*, shade-house conditions produced greater plant size and wider leaves than outdoor conditions in *L. billardierei* (Table 4), although, except for plant length, differences in subsp. *tenuiseta* were not as pronounced as for subsp. *billardierei*. With the exception of the Mitre Lake accession, subsp. *tenuiseta* produced greater plant size (height and length, though probably not bulk) in outdoor conditions than subsp. *billardierei*. The low inforescence numbers (Table 3) of this subspecies may be indicative of its rarity and narrow distribution in the wild. Preliminary analysis of RAPD's data suggested that subsp. *tenuiseta* may be apomictic in nature (*pers com.* E.A. James).

Lachnagrostis punicea

Culm-lodging, lack of leaf-inrolling or folding and inflorescence entanglement were also features of

Table 4. Plant size, leaf width and leaf condition for accessions of *Lachnagrostis* taxa grown under shade-house conditions in the 2010-2011 growing season and under outdoor conditions in the 2011-12 season.

Taxon	Accession	Nursery conditions	Plant height, cm	Max. plant length, cm	Max. leaf width, mm
L. robusta	Lake Linlithgow	outdoor	32	32	2.0[a], 3.0[b]
	Carranballac	shade-house	30	65	5.5[b]
		outdoor	32	32	1.5[a], 3.0[b]
	Wingeel	outdoor	32	32	1.5[a], 2.5[b]
	Telfers Swamp	outdoor	30	30	3.0[a], 4.0[b]
	Holm Hill	outdoor	45	45	3.0[b]
	Lenunga	outdoor	31	31	3.5[b]
L. billardierei* subsp. *billardierei	St Marnocks	outdoor	11	18	8.0[b]
	Tilley Swamp	shade-house	36	55	10.0[b]
		outdoor	12	20	5.0[b]
	Reedy Creek	shade-house	33	42	9.0[b]
	Piccaninnie Ponds	outdoor	12	24	7.0[b]
	Mitre Lake	outdoor	22	25	6.0[b]
	Emita Beach	outdoor	11	11	6.0[b]
L. billardierei* subsp. *tenuiseta	Kelvedon Beach	shade-house	25	51	6.5[b]
		outdoor	22	30	6.0[b]
L. punicea* subsp. *punicea	Dartmoor	shade-house	28	56	3.5[b]
		outdoor	18	30	3.5[b]
	South Bulart	outdoor	23	26	1.5[a], 3.0[b]
L. punicea* subsp. *filifolia	South Bulart	shade-house	24	51	3.0[b]
		outdoor	19	32	1.5[a], 3.0[b]

[a] inrolled or folded, [b] flat – note: where both leaf conditions are listed, partially inrolled leaves were hand-flattened to obtain a flat measure.

L. punicea under shade-house conditions as they were for *L. robusta*. There were no discernible differences in vegetative growth or inflorescence production between the subspecies of *L. punicea*, which suggests that, the major, and perhaps only, genetically based difference between them (lemma hairiness) is controlled by a single gene.

Growing conditions can obviously have important influences on the growth habit and phenology of these *Lachnagrostis* taxa. Phenotypic plasticity needs to be understood before differences, observed between field populations of the same species, promote the potential false establishment of new subspecies or varieties. Where species may be taken out of their natural environments for use in agricultural or nursery pursuits, it might well be expected that character change will occur and those features for which the plant was initially selected may not be maintained

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